# PATENT SPECIFICATION (11) 1 459 589

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(19)


## (54) ROPE TERMINAL FITTING


(71) We, BRIDON LIMITED, of Warmsworth Hall, Doncaster, Yorkshire, DN4 9JX, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—


This invention relates to rope terminal fittings allowing rapid separation of the rope from the item to which it is connected by the fitting, and is particularly useful for terminating the anchor ropes of marine oil rigs.

Floating structures such as oil rigs are maintained on location by anchor lines, usually at least eight in number. In the normal course of events, but especially in an emergency, such rigs need to move from their assigned location with the minimum of delay, the operation involving tripping the anchors and housing them together with the anchor lines. The task of tripping each anchor is normally undertaken by a workboat heaving on a pennant line until the anchor is clear of the sea bed, thereby enabling the rig to haul in the anchor line and anchor via its own storage winch; the success of the operation and, in certain circumstances the safety of the rig, depends upon the ability of the workboat to lift the anchors. Circumstances could arise in which a workboat is not available, or weather conditions make it impracticable for the workboat to undertake the operation, it still being imperative that the rig be free to move from its location.

The present invention is based on the idea of providing a readily separable connection between the anchor line and the anchor.

Our co-pending Application No. 14372/73 (Serial No. 1,423,595) relates to a rope terminal fitting comprising two end parts interconnected by an intermediate part, one end part being adapted to receive the end of a rope, in which the intermediate part is releasably connected to the end parts and has an internal cavity containing or adapted to contain an explosive charge.

The present invention concerns a modification of this fitting suitable for use in situations where an explosion would be dangerous or undesirable. In accordance with the present invention, the explosive charge is replaced by a pyrogenic charge and consequential structural changes are made in the fitting.

Accordingly, the present invention provides a rope terminal fitting comprising two end parts interconnected by an intermediate part, one end part being adapted to receive the end of a rope, the intermediate part being releasably connected to the end parts, in which between the end parts the fitting has a cavity containing a pyrogenic charge which, when ignited, heats the intermediate part and causes it to lose its strength so that the end parts can be pulled apart.

When a rope is to be separated rapidly from the item (e.g. an anchor) to which it is connected by the fitting, the pyrogenic charge is ignited and the heat generated by it causes the intermediate part to lose its strength to such an extent that the two end parts of the fitting can simply be pulled apart by tension applied to the rope. The intermediate part may lose its strength, for instance, by softening or melting locally. In order to localise the heat generated by the pyrogenic charge, it is preferable for the cavity to be an annular cavity encompassing the intermediate part.

The fitting preferably has a passage or passages extending from the cavity into the end part which is to receive the rope, so as to allow electrical ignition wires to be connected between the charge and an electrical converter housed in this end part; the converter will be connected to conducting wires running along the rope. A converter is an electrical device which converts a low-power electrical input into a pulsed, high power output.

In another aspect the invention provides a steel wire rope having the above terminal fitting. It is convenient for the rope construction to incorporate at least two insulated elec-

trically conducting wires allowing an ignition current to be passed along the rope itself.

The invention will be described further, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a longitudinal section of a rope terminal fitting;

Figure 2 show the central part of Figure 1 on an enlarged scale;

Figure 3 is similar to Figure 1 and shows an alternative embodiment of rope terminal fitting;

Figure 4 is an isometric-sectional view of part of the fitting shown in Figure 3;

Figure 4*a* is an isometric-sectional view of a modification of the part shown in Figure 4;

Figure 5 is an isometric view of an adaptor to permit conversion of the end parts to a non-separable coupling; and

Figure 6 is a cross-section through the central part of another rope terminal fitting.

One end part of the rope terminal fitting illustrated in Figure 1 is a separable socket or basket 1 of frusto-conical shape, within which the brushed end of a steel wire rope 2 is encapsulated in a cone 3 of chemically activated thermo-setting resin, e.g. epoxy, polyester, or polystyrene-latex. The basket 1 merges at its widest end into a parallel-walled section 4, threaded internally with a screw-thread 5 enabling a disposable intermediate part 6 to be firmly but releasably attached.

Primarily the disposable part 6 comprises a stepped metal body, e.g. of steel to British Standard Specification EN.26, the ends 7 and 8 of which are externally screw-threaded. The larger end 7 is of such diameter as to be capable of acting as a screw plug within the basket 1. The smaller end 8 is screwed into a threaded blind bore 9 in an anchor connector 10, so that the intermediate part 6 effects positive connection between the two end parts 1 and 10.

Between the basket 1 and the connector 10 is an external circular annular cavity 11 encircling the intermediate part 6. The cavity is of sufficient length and depth to accommodate a pyrogenic charge 13, the charge being contained by a watertight casing 14 which is capable of accepting compressible sealing rings 15 and 16 at either end.

The watertight casing 14 is tubular and has internally disposed location rings 12 and 17 to facilitate retention of the pyrogenic charge 13 and its ignition electrodes 27, 28 in correct relationship.

The terminal fitting is assembled by the conventional encapsulation of the brushed end of the rope 2 withinn the basket 1, using a chemically activated synthetic thermo-setting resin. One pair (or more) of insulated electrically conductive copper or copper alloy wires 20 and 21 forming part of the rope construction are allowed to protrude beyond the top of the resin cone 3. The wires 20, 21 are then led through respective holes 22 and 23 in a guide plate 24 fitted into the basket 1.

After being shortened to a convenient length, the wires 20, 21 are connected to the input terminals of a converter 19 mounted on the plate 24 and housed in a space 31 between the plate 24 and the part 6. The converter is a known device comprising integrated electrical circuits which convert a continuous low-power input into a pulsed high-power output. Wires from the output terminals of the converter are sweated into respective electrical contact members 25 and 26, which are to make sliding or rotary contact with the respective ignition electrodes 18 located within respective passages 29 and 30 in the disposable part 6. The space 31 may be filled with such a potting compound as "Selastic" (Trade Mark). The converter 19 supplies either continuous pulses to raise ignition elements 27, 28 to, and maintain them at, a temperature of at least 1100° C. (at which the charge 13 ignites), or separate high energy pulses (e.g. repetitive electrical discharges) to ignite a primary igniter within the charge. Alternatively, the converter can be omitted if sufficient power can be transmitted along the rope.

After the sealing ring 15 and a sealing ring 32 have been positioned on the end of the basket 1 and the disposable part 6 has been screwed in, the watertight casing 14 and pyrogenic charge 13 are positioned around the part 6. Further sealing rings 16 and 33 are then positioned, as shown, followed by screwing the anchorage connector 10 onto the threaded end 8 of the part 6, until all the seals are fully compressed and watertight, at which point the terminal fitting is ready for use.

Alternatively, the disposable part may be modified as shown in Figures 3 and 4. In this embodiment, the narrower section 34 of the disposable part 6 has a threaded end which extends freely through a bore 35 in the anchor connector 10 and on into a recess 36, where a nut 37 and a compression washer, serving as a sealing ring 38, are fitted. Tightening the nut 37 brings the various components—in the manner already described—into watertight compression via the sealing rings, whereupon the terminal is ready for use.

Yet another embodiment of the part 6 is shown in Figure 4*a*. The narrower section 34 is formed as a bolt with a head 43 which bears on a compression washer serving as a sealing ring 38. The larger end 7 of the part 6 has a screw-threaded blind bore into which the section 34 is screwed to complete the assembly of the fitting.

Actual separation of the terminal fitting is effected by passing an electrical current along the wires 20, 21 located within the anchor rope, to the converter 9 whose output is fed through the electrodes 18 to the pyro-

genic charge 13, which ignites and, in approximately five seconds, rises to a temperature of about 6000° C. During this time the portion of the disposal part 6 encompassed by the pyrogenic charge 13 is sufficiently softened (a minimum loss of tensile strength by a factor of 10 is required) to be no longer capable of maintaining the sustained linear tension exerted on the fitting by the rope, and is consequently pulled apart, separating the end parts 1 and 10.

The advantages offered by this terminal fitting are that:

1. it avoids the generation of underwater shock waves;
2. the thermal effect is strictly localised, being confined entirely to the disposable part, and particularly to that portion encompassed by the pyrogenic charge;
3. it can be transported and handled safely;
4. that there is little risk of re-usable components being damaged or distorted;
5. should circumstances arise where it is desired to use the fitting in a non-separable system, the two end parts 1 and 10 are readily coupled by the adaptor shown in Figure 5 which comprises a cylindrical plug 39, the central portion 40 of which has the same external diameter as the casing 14. One end 41 is machined and externally threaded to screw into the basket 1; the opposite end 42 is machined and screw-threaded to permit its attachment to the anchor connector 10.

Various modifications may be made within the scope of the invention. For example, as illustrated in Figure 6, the single central elongate bolt-like member of the disposable intermediate part 6 may be replaced by a plurality (e.g. six) of spaced, parallel elongate elements 34′ of smaller diameter each encompassed by the pyrogenic charge. Preferably, the elements 34′ are in a circle and are each surrounded by an individual portion 13′ of the pyrogenic charge, the charge portions being separated from each other by partitions 44 but being interconnected by fuses 46. In addition, each charge portion is provided with its own ignition arrangement (not shown) in order to ensure a fail-safe system in which (because of the interconnecting fuses) the whole pyrogenic charge will be ignited even if all but one of the ignition arrangements fail.

WHAT WE CLAIM IS:—

1. A rope terminal fitting comprising two end parts interconnected by an intermediate part, one end part being adapted to receive the end of a rope, the intermediate part being releasably connected to the end parts, in which between the end parts the fitting has a cavity containing a pyrogenic charge which, when ignited, heats the intermediate part and causes it to lose its strength so that the end parts can be pulled apart.

2. A fitting as claimed in claim 1, having a passage or passages extending from the cavity into the end part which is to receive the rope, so as to allow electrical ignition wires to be connected between the charge and an electrical converter housed in this end part.

3. A fitting as claimed in claim 1 or 2, in which the intermediate part is screwed into both end parts.

4. A fitting as claimed in any of claims 1 to 3, in which the cavity comprises an annular cavity encompassing the intermediate part.

5. A fitting as claimed in claim 4, in which the annular cavity is closed externally by a tubular casing.

6. A fitting as claimed in claim 4 or 5, in which the annular cavity encompasses a solid elongate central portion of the intermediate part.

7. A fitting as claimed in claim 4 or 5, in which the annular cavity encompasses a central portion of the intermediate part, the central portion comprising a plurality of spaced parallel elongate elements.

8. A fitting as claimed in claim 7, in which each elongate element is surrounded by an individual portion of the pyrogenic charge, the charge portions being separated by partitions but being interconnected by fuses.

9. A rope terminal fitting substantially as described herein with reference to Figures 1 and 2 or Figures 3 and 4 or 4*a* of the accompanying drawings.

10. A rope terminal fitting substantially as described herein with reference to Figure 6 of the accompanying drawings.

11. A steel wire rope having a terminal fitting as claimed in any preceding claim.

12. A steel wire rope as claimed in claim 11, including at least two insulated wires of a material having an electrical conductivity considerably higher than that of steel.

13. A floatable marine oil rig having anchor ropes constituted by steel wire ropes according to claim 11 or 12.

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1459589 COMPLETE SPECIFICATION
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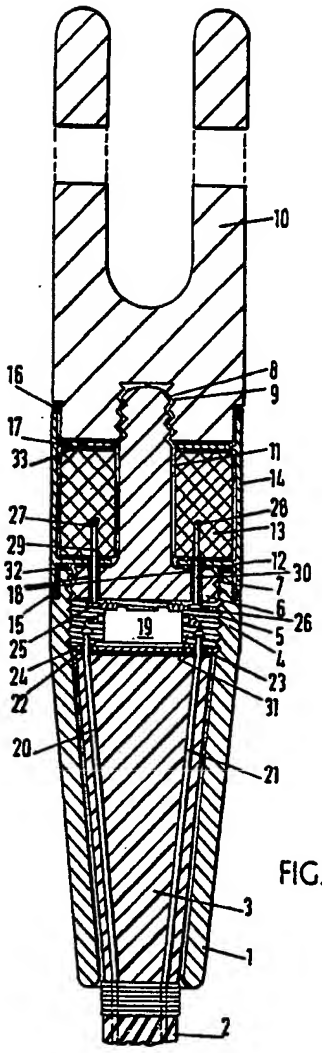


FIG. 1.

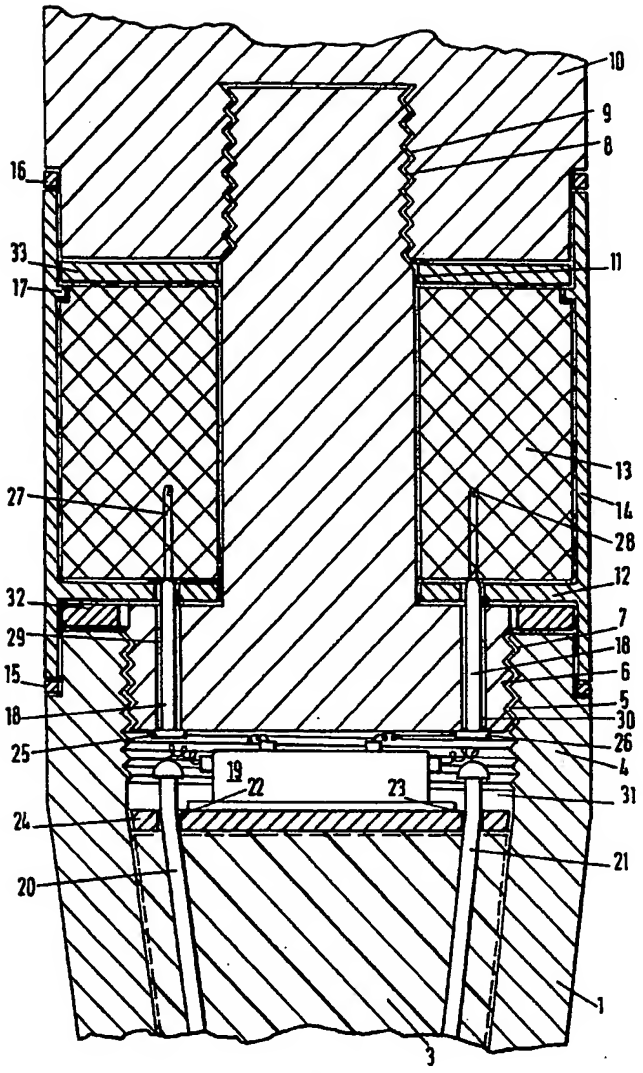
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FIG. 2.

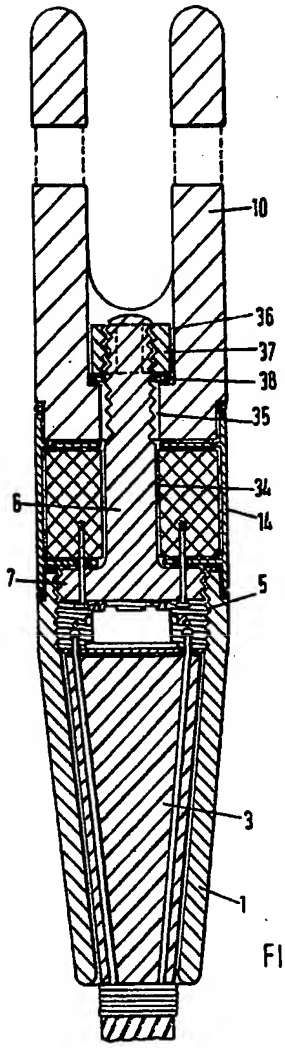


FIG. 3.

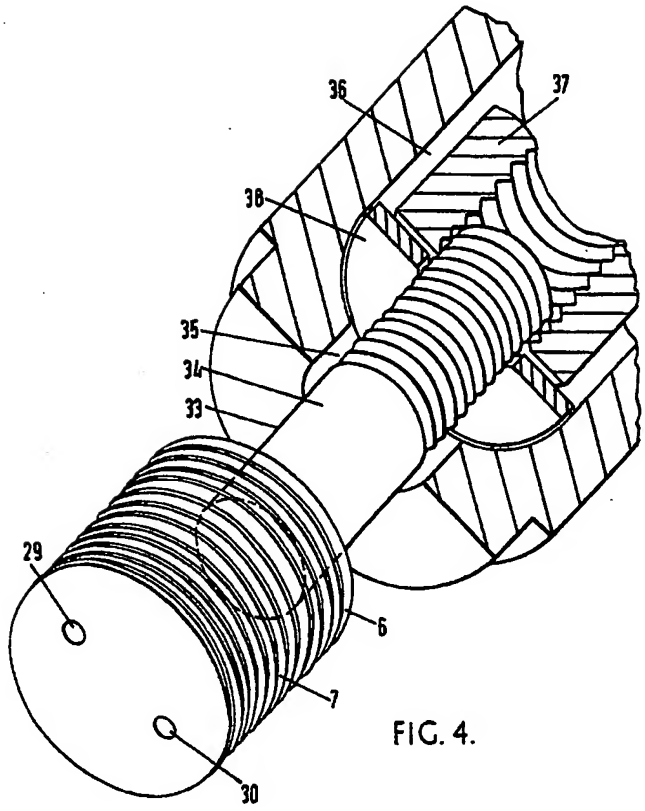


FIG. 4.

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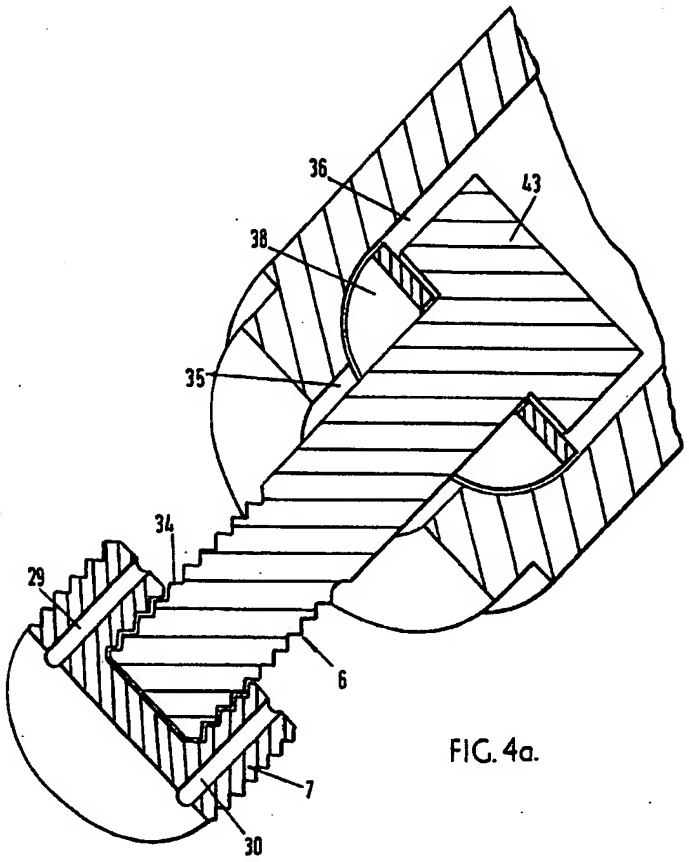


FIG. 4a.

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Sheet 6

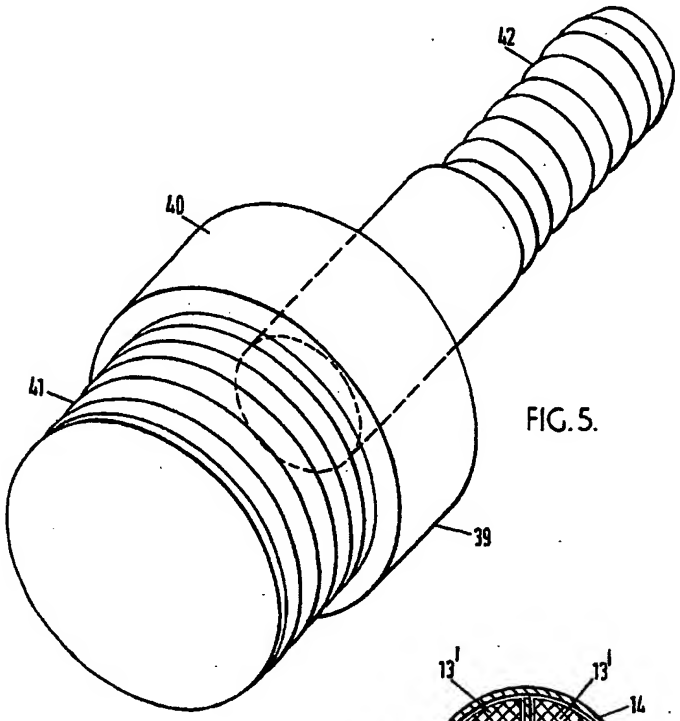


FIG. 5.

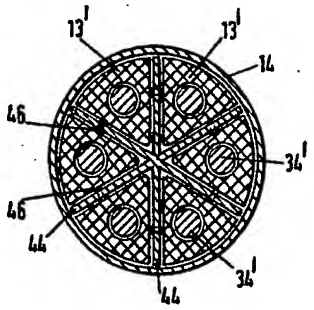


FIG. 6.